

natural orifices of respiration causes, "by sympathetic or reflex action, spasmodic occlusion of the sphincters or orifices of respiration, and stopping of respiratory movements." The death from drowning, the author argues, is therefore analogous to that from tetanic affection of the muscles of respiration. The two principal experiments are, that of two animals, in whose opened trachea a canula has been inserted; the lungs of the one which had been entirely submerged under water contain only the usual small quantity of frothy fluid; while the air-passages of the other, whose head had been kept out of the water, are filled with that fluid.—*Brit. and For. Med.-Chir. Rev.*, July, 1861, from *Comp. Rend.*, vol. i. 1860.

4. *Modes of Death from Chloroform.*—Much difference of opinion exists as to the nature of the death of those in whom chloroform has proved fatal. Whether death is due to syncope or to apnoea; to paralysis of the circulation or of respiration, or whether either may be the cause of death, is still a mooted question. Dr. A. E. SANSOM states, as the result of his investigation, that either of these may be the cause of death. He observes (*Lancet*, Aug. 24, 1861) "all the vital functions in etherization are depressed by an altered blood. What link is first snapped asunder in fatal cases is determined by various causes. In animals respiration fails first because the automatic power of their hearts enables its movements to persist. In man, circulation usually first fails because the heart is the most susceptible of the incomplete stimulus. In animals death occurs by asphyxia, and death begins in the brain. In man, death occurs by syncope or by asphyxia, and death begins in the brain, in the heart, or in the lungs. Practical men may learn a useful caution from this; for it has been said, that in cases of danger the pulse is to be disregarded, and the embarrassment of the breathing taken as the critical sign. If I may be permitted to express dogmatically what I have learnt by experience, I would say: Rely almost wholly on the pulse. Disregard dyspnoea if the pulse be good; but if the pulse show signs of failing, withdraw the chloroform, and consider the condition a condition of danger.

## MATERIA MEDICA AND PHARMACY.

5. *Rules for the Administration of Chloroform.*—Dr. W. MARCET has published (*Med. Times and Gaz.*, July 20, 1861) some interesting practical observations on the action of chloroform.

"When chloroform," he observes, "is inhaled, and consequently brought into contact with the air-cells of the lungs, it passes rapidly into the blood, by means of which it is carried to the brain. If the administration of the anæsthetic agent be suspended, the chloroform will be eliminated from the body by the respiration, each inspiration displacing most of the vapour contained in the blood exposed by the lungs to the action of air during that inspiration. The elimination from the blood of any very volatile substance possessed of a stable chemical composition may be considered, as a rule, to take place through the lungs. This might have been anticipated by a consideration of the displacement of the carbonic acid of the blood by the air inspired, and has been placed beyond doubt by a well known beautiful experiment of Claude Bernard, where an aqueous solution of sulphuretted hydrogen being injected into the blood of a dog, the animal in the course of one or two minutes expires the whole of the poisonous gas. Messrs. Lallemand, Perrin, and Duroy have shown experimentally that this law is applicable to chloroform, and consequently there is not the slightest doubt that when blood contains chloroform it is removed therefrom by means of respiration.

"If the air inspired be pure, the displacement of chloroform from the blood in the lungs will be very great; if this air should contain chloroform the displacement will be less, just as when air containing a large proportion of carbonic acid is breathed, the removal of the carbonic acid of the blood is checked. When a

patient begins to inhale chloroform, a portion is absorbed by the blood, the remaining is expired; but shortly afterwards, in addition to the expiration of that part of the chloroform, which has not been taken up by the blood, a certain quantity of that which has been absorbed is also ejected, being displaced by the air mixed with the chloroform inhaled. At this stage, however, there is still an accumulation of the anæsthetic agent in the blood, more being taken into the circulation than given out; gradually complete insensibility is produced, and the handkerchief is removed from before the face of the patient; he now begins ridding himself rapidly of the chloroform, and recovers consciousness, unless more of the anæsthetic agent be exhibited. By the careful administration of chloroform the state of insensibility may be kept up for a considerable length of time; during this period it is obvious that the accumulation of the vapour in the blood no longer takes place, otherwise it would invariably produce death, there must consequently be an equilibrium between the quantity of chloroform absorbed, and that which is displaced and eliminated by the process of respiration. If, during this stage of insensibility from any cause whatever, the power of absorption of the blood for chloroform be suddenly increased, or its property of giving it out to the air inspired be diminished, then death will take place from an accumulation of the vapour in the blood. It is difficult to imagine that the power of blood of absorbing the substance under consideration should be suddenly increased; but there is a very simple cause impairing its elimination from the blood, viz., the administration of the chloroform vapour in too concentrated a condition. Just as an excess of carbonic acid in the air prevents or interferes with the elimination of that contained in the blood, so must an excess of chloroform in the air prevent or interfere with the exit of chloroform already existing in the blood; therefore, the blood goes on taking up chloroform, and giving out less than a quantity equal to that absorbed, at the same time the evil may be increased by a few deep inspirations taken unconsciously, although apparently with the view of ejecting the poison, and life is suddenly extinguished."

These observations lead him to the following conclusions:—

"1. That chloroform must be administered cautiously, and its effects watched with particular attention, if, although the vapour be freely inhaled, the patient does not become insensible within the usual time.

"2. That in every case where chloroform is administered, as soon as the state of insensibility is obtained, the vapour must be exhibited diluted as much as possible with pure air; and air free from the anæsthetic agent ought to be allowed frequently into the lungs to remove the excess of the vapour present in the blood.

"3. That during the administration of chloroform great attention should be paid to the state of the respiration, which ought to guide the exhibition of the anæsthetic agent still more than the condition of the pulse. If the inspirations become less deep and respiration appear failing, air free from chloroform ought to be immediately allowed into the lungs, not only because this state of the respiration is an indication of there being an overdose of chloroform in the blood, but also because the diminished respiration is in itself a cause of danger by preventing the blood from ridding itself of the chloroform it contains.

"4. That when a patient has sunk under the effects of poisoning by chloroform the only means of restoring animation is by artificial respiration, adopting such method as is best calculated to introduce as much air as possible into the lungs in order to remove the poison from the blood, at the same time stimulating the action of the heart.

"It is due to Messrs. Lallemand, Perrin, and Duroy to state that they have already called attention to the importance of looking closely to the respiration during the administration of chloroform; but these gentlemen have overlooked the fact that the presence of an excessive proportion of chloroform in the air inspired must act more or less as an obstacle to the elimination of the vapour which has already been absorbed—a circumstance which ought to be taken into consideration on every occasion where chloroform is exhibited."

6. *Internal Administration of Chloroform.* By M. BONNET and Dr. DEBOUT.—In consequence of the difference in density between chloroform and water, it is rather difficult to administer the former drug as an internal remedy,